# Ticket printing device, in particular transport tickets, of different formats.

The invention relates to the field of ticket printing, such as transport tickets, from a thermal type print head.

A device for printing of this type is normally equipped with means of driving the tickets capable of causing the ticket to move across the print head, presenting a principal face of the ticket to the head.

In Patents FR 88 00734 and FR 88 00733, the Applicant described a ticket printing device equipped with a thermal print head and means of driving the tickets including a block formed from a powered rotating roller, and applied against a face of the ticket, opposite the face presented to the print head. The device also includes means of guidance which define a direction of travel of the ticket under the print head. The block is substantially perpendicular to the direction of travel of the ticket such that the roller, in rotation, exerts a tangential force on the ticket to cause it to move under the print head.

Such a device was found to be effective for the printing of identical tickets, particularly of the same width (viewed in a direction perpendicular to the direction of travel).

However, the Applicant was faced with the problem of providing a printing device capable of operating on tickets of different formats, in particular of different widths.

The present invention provides a solution to this problem.

It relates to a printing device including :

- at least one thermal print head,

- driving means arranged to move the ticket across the print head, presenting a first principal face of the ticket to the print head, and
- means of guidance capable of imparting a direction of travel to the ticket.

According to a general characteristic of the invention, the driving means include a block applied against a second face of the ticket, opposite to the first principal face, and including a first powered rotating roller capable of causing the ticket to move, and a second idling roller, extending beyond the powered roller, which is used to drive tickets of different widths in the direction of travel.

Thus, it is no longer necessary, in a device according to the invention, to motorise the entirety of the block. Provision may therefore be made for a motor of sufficient capacity to drive the powered roller only.

Preferably, the powered roller and the idling roller are respectively generally cylindrical in shape, substantially co-axial and similar in radius. In addition, the motorised roller and the idling roller are substantially juxtaposed.

Advantageously, the guidance means include, with regard to the motorised roller, at least one wall parallel to an edge of the ticket, forming a tab capable of defining the direction of travel of the ticket, while the block forms a chosen angle with said direction of travel.

Preferably, the guidance means include, along the direction of travel, an upstream tab and a downstream tab, substantially juxtaposed and placed on either side of the powered roller.

According to another advantageous optional characteristic, the block forms, in the direction from the powered roller towards the idling roller, with a direction of movement of the ticket towards the print head, an angle of between 89° and 90°, preferably in the region of 89.7°.

Advantageously, the thermal print head includes a plurality of heating elements capable of releasing heat to enable printing of the ticket, while the device includes means to electrically test the elements, one by one, these testing means utilising a heating element addressing module customarily used for thermal printing.

According to another advantageous optional characteristic of the device according to the invention, provision is made for means of supporting the print head including a flexible plate fixed, on one hand, to the print head and, on the other hand, to a mounting integral with the block, together with a rigid plate fixed to the print head and equipped with an end bar substantially parallel to the direction of travel and seated so as to rotate about an axis substantially parallel to this direction of travel in an aperture incorporated into said mounting. Thus, this rigid plate is capable of preventing pitching motion of the print head whilst at the same time allowing a rolling motion about the axis of rotation of the bar.

Advantageously, provision is also made for means of pushing the plate against the block, the print head being in a position facing the block.

Other characteristics and advantages of the invention will become apparent upon examination of the detailed description below and the attached diagrams in which :

- figure 1 is a general view of a printing device according to the invention;
- figure 2A illustrates a print station TT of the device shown in figure 1, viewed from the right;
- figure 2B illustrates the station TT shown in figure 2A, viewed from the front;
- figure 2C illustrates the station TT shown in figure 2A, viewed in perspective from the right;
- figure 2D illustrates the station TT shown in figure 2A, viewed from the left;

- figure 3 illustrates the relative arrangement of a block, a tab and a print head of the station shown in figure 2;
- figure 4 illustrates an exploded view of the support elements of the print head; and
- figure 5 gives a schematic representation of the means of testing the operation of the heating elements incorporated in the print head.

The detailed description below and the attached diagrams contain, for the most part, elements of certain character. They may therefore serve not only to facilitate a better understanding of the invention, but also contribute to its definition, if required.

A description is given below, by way of non-limitative example, of the printing of tickets carrying magnetic information.

Reference will first be made to figure 1 to describe a ticket printing device, for transport tickets in the example described, said tickets including a magnetic stripe carrying information.

For example, the processing device is that described in the Patent Application filed by the Applicant on the same day as the present Application, and entitled "Ticket processing device with thermal printing and magnetic recording/reading on an internal path in closed circuit". For all necessary purposes, the description of this Application forms an integral part of the detailed description below.

The printing device DIS makes use, in the example described, of a three-way feed of ticket strips arranged fan-fold. Three storage magazines (not shown) each containing a continuous stock of tickets in strips separated by means of lines of weakening (pre-perforated strips) can thus feed a ticket printing device according to the invention.

Strips of tickets are introduced, at the station PIN, via three guide channels CA1, CA2 and CA3 which converge towards each other and are fitted with separate driving means, in this case composed of rollers and backing rollers 1, 3 and 5. The ticket strips are then moved in the direction of the arrow F1 across a magnetic record/read head PIL including a first magnetic recording head TM1, followed by a second magentic reading head TM2. As a variant, the magnetic record/read head PIL may only include a single magnetic head. In this case, the strip passes across the single magnetic head several times.

The driving means are then arranged to move a ticket along an internal bidirectional path F1 and F2, leading from the feed station to the delivery station DEL via the magnetic record/read head.

It will be noted that, in the example described, the entry to channel CA1 is defined by two rollers 7 and 9 which are mounted freely to avoid any friction between any fixed parts and the moving strip. The entry to feed channel CA2 is defined by rollers 9 and 11, while the entry to feed channel CA3 is defined by rollers 11 and 13. Thus, at point 2 in figure 1, the three feed channels CA1, CA2 and CA3 converge, thus bringing the strip of tickets to point 2.

In practice, the driving means include a belt C1 wound onto a roller 4, and also onto the roller 6 via the heads TM1 and TM2, and is wound onto rollers and 8 and 10 to continue the internal path. The belt C1 is driven in closed circuit by means of a drive roller 12 integral with the shaft of the motor M1. A control unit UC, of the micro-controller type, controls the motor M1 and therefore the transmission of drive to the belt C1.

It will also be noted that above the roller 13, as shown in figure 1, provision is made for other means (not shown) of moving tickets fed from a fourth magazine containing a strip of tickets of different width from the other strips.

Once the magnetic information has been recorded on a ticket (followed by immeriate reading of the information), the strip is directed into a guide channel CG1 to a cutting station COU which includes an electromagnetic guillotine fitted with an electro-magnet EM1 with a plunger carrying the cutting part (not shown).

In practice, the strip is held taut between two rollers of dissimilar evolute. This tension facilitates separation of one ticket from the continuous stock along the aforementioned lines of weakening. In particular, this separation is effected by lowering the guillotine onto the strip thus held taut. Provision may be made for optical detection, for example, of the said lines of weakening to control the action of the guillotine.

Once cutting has been completed on the ticket concerned, the control unit UC actuates the motor M1 in the direction F2, opposite to the direction F1, in order to move the cut ticket to the thermal print station TT. Thus, having been cut and magnetically recorded/read, the ticket is directed to a guide channel CG2 separate from the feed channels CA1, CA2 and CA3.

Referring now to figures 2A to 2D. Provision is made for means of supporting the print head 24 including a flexible plate 224, forming a hinge without play, fixed on one hand to the print head 24 and on the other hand to a mount 25 supporting the block 26 arranged to rotate and positioned facing the head 24.

The block is driven in rotation by a belt 263 connected via rollers (not shown) to the shaft of the motor M2.

The arm 22 is guided in rotation about a rod 253 integral with the mount 25. The arm is capable of applying force on the head 24 and flexible plate 224 assembly via a spring 223 thereby causing the print head to tilt on the block 26.

When activated, the electro-magnet EM2 causes the arm 22 to rotate about the axis 253, by lengthwise displacement of its core, which bears on the arm 22 which, in the example shown, is retained by a return spring RR.

A rigid plate 221 plays the role of a backing plate fixture. At the same time, it serves to limit the degree of freedom of the mobile assembly formed by the head 24, the plate 224 and the supports 226 and 225.

Movement of the assembly 24, 224, 221 is obtained by the effect of the plate 221 which imparts a rolling motion to the head 24 through the linkage to the bar 222 and its seating 251.

Thus, when the electro-magnet EM2 is electrically activated, its core moves lengthwise and bears against the arm 22, which then pivots about the axis of rotation A2 of the rod 253, causing the thermal print head to tilt towards the block 26.

Rotation of the assembly formed by the head 24, the rigid plate 221 and the flexible plate 224, causes the blade 224 forming a hinge without play to bend.

The block 26, held about its axis of rotation A1 by the housing 254 supported on the mount 25, is thus integral with the mount, whereas the thermal print head 24 pivots relative to the mount about the axis A2. Thus, the ticket moving in the direction shown by the arrow D is clamped between the block 26 and the thermal print head 24 when the latter is in the position where it is tilted against the block 26.

When the thermal head 24 is applied against a first principal face of the ticket, the block 26 is applied against a second principal face of the ticket, opposite to the first face. The block 26, in rotation, exerts a tangential force, by friction, on the second face of the ticket, thereby causing the first face to move across the print head 24 in the direction of travel D.

In the example described, the first face of the ticket is coated with a material of which the colour changes irreversibly in relation to temperature. The thermal print head 24 incorporates electrically operated heating elements which release heat, by the Joule effect, capable of changing the colour of the ticket (to black for example) on its first principal face. Operation of the motor M2 driving the belt 263 to rotate the block, and the distribution of electrical current in the elements of the thermal print head 24, are controlled by the aforementioned micro-controller UC, advantageously in a coupled manner.

Reference will now be made to figure 3 to describe in greater detail the structure of the block 26.

According to the invention, the block 26 is formed by a first roller 261, which is powered, and a second roller 262, which is idle. In practice, the block incorporates a pin 264, generally cylindrical in shape, drive in rotation by the belt 263, about A1. The powered roller 261 is integral with and fixed in relation to the pin 264, while the idling roller 262 is in rotation about A1 by sliding of its inner surface on the pin 264.

In the example described, the tickets are made of paper, while the outer surfaces of rollers 261 and 262 are made in a material with a large coefficient of friction on paper. Thus, as the ticket moves in the direction D, it is subjected to a tangential force from the powered roller 261, by friction, while the idling roller 262 is caused to rotate by the force exerted on its outer surface by the moving ticket. Thus, tickets of different widths can be driven towards the thermal print head 24, according to similar sequences of movement, avoiding any direct contact of the driving roller and the print head.

In the presence of a large format ticket (wider than the width of the drive roller), the two components of the block (drive roller and idling roller) turn.

The powered segment of the block 261 drives the ticket, which in turn drives the idling roller 262.

In the presence of a small format ticket (narrower than or equal in width to that of the drive roller 261), the drive roller drives the ticket and the idling roller is immobilised on the print head.

This arrangement (powered part and idling part of the block) thus avoids contact on a prohibitive surface between the rotating block and the head.

Undue consumption of electricity as pure energy loss, caused by friction of the powered block on the head, is thus avoided. This results in a reduction (capacity, volume) of the driving means (control and power supply electronics) required for normal operation of the device according to the invention. It will be noted that, with segmentation of the block into an idling part and a powered part, abrasion of the head by particles adhering to the block is also avoided (for example magnetic oxide dust particles).

Advantageously, the block forms an angle $\alpha$ with the direction of travel D effectively less than 90°. It will be noted here that the angle $\alpha$ is an algebraic angle, between two vectors :

- a first vector moving away from the powered roller towards the idling roller, and
- a second displacement vector represented by the arrow D.

Preferably, the angle $\alpha$ is between 89° and 90°, for example close to 89.7°.

The aforementioned guidance means advantangeously include guide tabs TG1 and TG2 to hold the ticket along the direction of travel D. The two tabs TG1 and TG2 are placed on either side of the powered roller 261 (more particularly on either side of the belt 263, as shown in figure 3).

The angle α formed by the block 26 with the direction of travel D helps to lay the tickets against the tabs TG1 and TG2, while the idling roller 262 advantageously serves to hold the ticket without presenting any resistance. Thus, one of the major advantages afforded by the present invention lies in the fact that it becomes possible to print tickets of different formats, in particular of different widths. It will be noted that the width of the tickets in this case is taken to mean their dimension in the direction perpendicular to the direction of travel D, therefore substantially along the block 26.

It will be further noted that in a simplified variant of the device according to the invention, the means of guidance of the print station TT may only include a single tab, preferably tab TG2 located downstream of the block 26 in the direction of the travel D of the ticket.

Preferably, the width of the powered roller 261 is close to that of the narrower tickets. Furthermore, the idling roller 262 is adjacent to the powered roller 261. Provision is made for a wall 266 with a small coefficient of friction and fixed to the pin 264, enabling the idling roller 262 to be held against the powered roller 261. Provision may also be made for a thin wall with a small coefficient of friction, fixed to the pin 264, between the powered roller 261 and the idling roller 262.

Reference will now be made to figure 4 to describe, in greater detail, the means of support for the thermal print head 24.

Overall, these means of support are composed of an arm 22, on the end of which the core of the electro-magnet EM2 (figure 2) is intended to bear. The arm 22, forming a lever, is integral with a frame 227 on which is mounted the head 24, via an assembly of parts 221, 224, 223, 226 and 225.

The part 225 is a spacer plate which is removable, making it possible to fit two types of thermal print head 24, of different respective thicknesses.

The part 226 is a fixing plate to which are secured the spacer plate 225 and the head 24. Thus, the fixing plate 226 is designed to be mounted in the frame 227, by means of the parts 223, 224 and 221.

Part 221 corresponds to the rigid plate shown in figure 2. It is fixed to the plate 226, without the provision of means of direct fixing to the frame 227. The bar 222 extending from said plate fits into the aperture 251 which includes a part 252 designed to be secured by the screws 255 to the mount 25 (figure 2). Thus, the rigid plate 221 is able to pivot about the axis A3, substantially parallel to the direction of travel D of the tickets, making it possible to impart a degree of freedom which corresponds to a rolling clearance about the axis A3 of the thermal print head 24. In relation to the axis of rotation A2, the head 24 is substantially immobilised by means forming springs 223, and also by a flexible plate 224 fixed, on one hand, to the plate 226 and, on the other hand, to the part 252 (via its apertures 227), and therefore the mount 25. The spring 223 is mounted between the fixing plate 226 and frame 227. It will be noted that compression of the spring 223 can be adjusted to a desired pressure, exerted by the head 24 on the tickets or, in practice, according to the characteristics of the tickets (thickness, smoothness, etc.). Advantageously, the rigid plate 221 thus serves to eliminate undesirable pitching motion of the print head 24, while at the same time enabling it to roll about the axis A3.

As shown in figure 4, the bar 253 is inserted into seatings incorporated in the arm 22 carrying the frame 227. It is fixed to the arm 22 by fixing means 256 and thus pivots, about the axis A2, relative to the mount 25 in seatings incorporated into the latter (figure 2).

Reference will now be made to figure 5 to describe the means of testing the resistance heating elements R of the print head 24, which the device according to the invention advantageously includes.

In the example, the resistance elements R, substantially aligned, are supplied by a voltage V. A measuring console MES, controlled by the aforementioned control unit UC, includes a selector S operated by the console MES, and a current measuring device A connected to the measuring console MES.

The selector S is positioned on a selected heating element whose efficiency or resistance value it is desired to measure. The current consumed in the supply branch B indicates, when it is below a chosen threshold, wear or breakage of the element concerned. In pratice, the selector corresponds to the addressing register for the resistance elements of the print head customarily used for printing. It will be noted however that the current passing through the resistance elements for test purposes is, in this case, less than the current used for thermal printing, which notably makes it possible to test the elements with a reduced electricity consumption.

Thus, the unit US includes a module MOD for addressing the resistance elements. In practice, this module includes an address register, each address being relative to a resistance element Ri, enabling each element to be tested separately.

Such testing makes it possible advantageously to check the precision of printing, in particular for the printing of barcodes which correspond to magnetic information carried on a magnetic stripe provided on each ticket.

Of course, the present invention is not limited to the embodiment described above by way of example; it extends to other variants.

Thus, it is to be understood that the invention also applies to the printing of tickets other than transport tickets, for example parking payment tickets, fitted with a magnetic stripe. More generally, it may be applied to the printing of tickets with or without a magnetic stripe carrying information.

In the example described above, the tickets are made of paper coated, on at least one principal surface, with a material capable of changing colour in the presence of heat. As a variant, provision may also be made for a tape which deposits a material of a selected colour on the tickets, this material being rendered adhesive by thermal treatment. In particular, when the resistance elements release heat, this material is deposited on the surface of the ticket facing the head 24. Such a tape can move across the thermal print head, for example at the same speed as the ticket. It is then seated between the head and ticket.

Furthermore, in the example described above, the powered roller and the idling roller are juxtaposed. As a variant, a gap may be provided between the two rollers, of selected thickness. Also, in the example illustrated in figure 3, the two rollers are cylindrical in shape, of similar radius, and their axes of rotation are substantially coincident. As a variant, provision may be made to mount an idling roller of different radius from the powered roller, with parallel-offset axes, in a plane substantially perpendicular to the direction of travel of the tickets D, such that their respective contact surfaces with the ticket are substantially contiguous.

Of course, the means of support for the thermal print head 24, illustrated in detail in figure 4, are described above by way of example and are capable of alternative embodiments.